CLAIMS

We claim:

1. A method of forming a solder bump, comprising the steps of:

providing a structure;

forming a metal bond pad on the structure;

forming a patterned cover layer over the structure; the patterned cover layer including an opening exposing a portion of the metal bond pad; the patterned cover layer opening including side walls;

forming a metal cap layer over at least the exposed portion of the metal bond pad and the patterned cover layer side walls; and

forming a solder bump over the metal cap layer.

2. The method of claim 1, wherein the structure is a semiconductor wafer.

3. The method of claim 1, wherein the structure is comprised of silicon or germanium.

4. The method of claim 1, wherein the metal bond pad is comprised of aluminum or AlSi; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum or AlSi; and the solder bump is comprised of a tin lead alloy (SnPb), a tin silver copper alloy (SnAgCu), a tin silver alloy (SnAg) or a tin copper (SnCu).

5. The method of claim 1, wherein the metal bond pad is comprised of aluminum; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum; and the solder bump is comprised of a tin silver copper alloy (SnAgCu).

6. The method of claim 1, wherein the metal bond pad and the metal cap layer are each comprised of the same metal.

7. The method of claim 1, wherein the metal bond pad has a thickness of from about 0.5 to 1.5 μm; the patterned cover layer has a thickness of from about 5.0 to 10.0 μm; and the metal cap layer has a thickness of from about 0.5 to 1.0 μm.

8. The method of claim 1, wherein the metal bond pad has a thickness of from about 1.0 1.5 μm; the patterned cover layer has a thickness of from about5.0 to 6.0 μm; and the metal cap layer has a thickness of from about 0.8 to 1.0 μm.

9. The method of claim 1, wherein the patterned cover layer opening has a width of from about 30 to 90 μm.

10. The method of claim 1, wherein the patterned cover layer opening has a width of from about 30 to 60 μm.

11. The method of claim 1, wherein the metal cap layer is formed by sputtering.

12. The method of claim 1, including the step of:

subjecting the metal cap layer to a double zincation process.

13. The method of claim 1, including the step of subjecting the metal cap layer to a double zincation process to form:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; and

an immersion gold layer on the electroless nickel layer.

14. The method of claim 1, including the step of subjecting the metal cap layer to a double zincation process to form:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; the electroless nickel layer having a thickness of from about 4.8 to 5.2 μm; and

an immersion gold layer on the electroless nickel layer; the immersion gold layer having a thickness of from about 0.09 to 0.11 μm.

15. The method of claim 1, including the step of subjecting the metal cap layer to a double zincation process to form:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; the electroless nickel layer having a thickness of about 5.0 μm; and

an immersion gold layer on the electroless nickel layer; the immersion gold layer having a thickness of about 0.10 μm.

16. The method of claim 1, including the step of reflowing the solder bump to form a rounded solder bump.

17. A method of forming a solder bump, comprising the steps of:

providing a structure;

forming a metal bond pad on the structure;

forming a patterned cover layer over the structure; the patterned cover layer including an opening exposing a portion of the metal bond pad; the patterned cover layer opening including side walls;

forming a metal cap layer over at least the exposed portion of the metal bond pad and the patterned cover layer side walls;

subjecting the metal cap layer to a double zincation process; and

forming a solder bump over the metal cap layer.

18. The method of claim 17, wherein the structure is a semiconductor wafer.

19. The method of claim 17, wherein the structure is comprised of silicon or germanium.

20. The method of claim 17, wherein the metal bond pad is comprised of aluminum or AlSi; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum or AlSi; and the solder bump is comprised of a tin lead alloy (SnPb), a tin silver copper alloy (SnAgCu), a tin silver alloy (SnAg) or a tin copper (SnCu).

21. The method of claim 17, wherein the metal bond pad is comprised of aluminum; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the

metal cap layer is comprised of aluminum; and the solder bump is comprised of a tin silver copper alloy (SnAgCu).

22. The method of claim 17, wherein the metal bond pad and the metal cap layer are each comprised of the same metal.

23. The method of claim 17, wherein the metal bond pad has a thickness of from about 0.5 to 1.5 μm; the patterned cover layer has a thickness of from about 5.0 to 10.0 μm; and the metal cap layer has a thickness of from about 0.5 to 1.0 μm.

24. The method of claim 17, wherein the metal bond pad has a thickness of from about 1.0 1.5 μm; the patterned cover layer has a thickness of from about5.0 to 6.0 μm; and the metal cap layer has a thickness of from about 0.8 to 1.0 μm.

25. The method of claim 17, wherein the patterned cover layer opening has a width of from about 30 to 90 μm.

26. The method of claim 17, wherein the patterned cover layer opening has a width of from about 30 to 60 μm.

27. The method of claim 17, wherein the metal cap layer is formed by sputtering.

28. The method of claim 17, wherein the subjection of the metal cap layer to a double zincation process forms:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; and

an immersion gold layer on the electroless nickel layer.

29. The method of claim 17, wherein the subjection of the metal cap layer to a double zincation process forms:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; the electroless nickel layer having a thickness of from about 4.8 to 5.2 μm; and

an immersion gold layer on the electroless nickel layer; the immersion gold layer having a thickness of from about 0.09 to 0.11 μm.

30. The method of claim 17, wherein the subjection of the metal cap layer to a double zincation process forms:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; the electroless nickel layer having a thickness of about 5.0 μm; and

an immersion gold layer on the electroless nickel layer; the immersion gold layer having a thickness of about 0.10 μm.

31. The method of claim 17, including the step of reflowing the solder bump to form a rounded solder bump.

32. A method of forming a solder bump, comprising the steps of:

providing a structure;

forming a metal bond pad on the structure;

forming a patterned cover layer over the structure; the patterned cover layer including an opening exposing a portion of the metal bond pad; the patterned cover layer opening including side walls;

forming a metal cap layer over at least the exposed portion of the metal bond pad and the patterned cover layer side walls;

subjecting the metal cap layer to a double zincation process to form:

a double zincation activated surface on the metal cap layer;

an electroless nickel layer on the double zincation activated surface; and

an immersion gold layer on the electroless nickel layer;

and

forming a solder bump over the immersion gold layer.

33. The method of claim 32, wherein the structure is a semiconductor wafer.

34. The method of claim 32, wherein the structure is comprised of silicon or germanium.

35. The method of claim 32, wherein the metal bond pad is comprised of aluminum or AlSi; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum or AlSi; and the solder bump is comprised of a tin lead alloy (SnPb), a tin silver copper alloy (SnAgCu), a tin silver alloy (SnAg) or a tin copper (SnCu).

36. The method of claim 32, wherein the metal bond pad is comprised of aluminum; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the

metal cap layer is comprised of aluminum; and the solder bump is comprised of a tin silver copper alloy (SnAgCu).

37. The method of claim 32, wherein the metal bond pad and the metal cap layer are each comprised of the same metal.

38. The method of claim 32, wherein the metal bond pad has a thickness of from about 0.5 to 1.5 μm; the patterned cover layer has a thickness of from about 5.0 to 10.0 μm; and the metal cap layer has a thickness of from about 0.5 to 1.0 μm.

39. The method of claim 32, wherein the metal bond pad has a thickness of from about 1.0 1.5 μm; the patterned cover layer has a thickness of from about5.0 to 6.0 μm; and the metal cap layer has a thickness of from about 0.8 to 1.0 μm.

40. The method of claim 32, wherein the patterned cover layer opening has a width of from about 30 to 90 μm.

41. The method of claim 32, wherein the patterned cover layer opening has a width of from about 30 to 60 μm.

42. The method of claim 32, wherein the metal cap layer is formed by sputtering.

43. The method of claim 32, including the step of reflowing the solder bump to form a rounded solder bump.

44. The method of claim 32, wherein:

the electroless nickel layer has a thickness of from about 4.8 to 5.2 μm; and

the immersion gold layer having a thickness of from about 0.09 to 0.11 μm.

45. The method of claim 32, wherein:

the electroless nickel layer has a thickness of about 5.0 μm; and

the immersion gold layer having a thickness of about 0.10 μm.

46. A solder bump structure, comprising:

a structure;

a metal bond pad on the structure;

a patterned cover layer over the structure; the patterned cover layer including an opening exposing a portion of the metal bond pad; the patterned cover layer opening including side walls;

a metal cap layer over at least the exposed portion of the metal bond pad and the patterned cover layer side walls; and

a solder bump over the metal cap layer to form the solder bump structure.

47. The structure of claim 46, wherein the structure is a semiconductor wafer.

48. The structure of claim 46, wherein the structure is comprised of silicon or germanium.

49. The structure of claim 46, wherein the metal bond pad is comprised of aluminum or AlSi; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum

or AlSi; and the solder bump is comprised of a tin lead alloy (SnPb), a tin silver copper alloy (SnAgCu), a tin silver alloy (SnAg) or a tin copper (SnCu).

50. The structure of claim 46, wherein the metal bond pad is comprised of aluminum; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum; and the solder bump is comprised of a tin silver copper alloy (SnAgCu).

51. The structure of claim 46, wherein the metal bond pad and the metal cap layer are each comprised of the same metal.

52. The structure of claim 46, wherein the metal bond pad has a thickness of from about 0.5 to 1.5 μm; the patterned cover layer has a thickness of from about 5.0 to 10.0 μm; and the metal cap layer has a thickness of from about 0.5 to 1.0 μm.

53. The structure of claim 46, wherein the metal bond pad has a thickness of from about 1.0 1.5 μm; the patterned cover layer has a thickness of from about5.0 to 6.0 μm; and the metal cap layer has a thickness of from about 0.8 to 1.0 μm.

54. The structure of claim 46, wherein the patterned cover layer opening has a width of from about 30 to 90 μm.

55. The structure of claim 46, wherein the patterned cover layer opening has a width of from about 30 to 60 μm.

56. The structure of claim 46, wherein the metal cap layer is formed by sputtering.

57. The structure of claim 46, wherein the metal cap layer is subjected to a double zincation process.

58. The structure of claim 46, including:

a double zincation activated surface on the metal cap layer;

a electroless nickel layer on the double zincation activated surface; and

an immersion gold layer on the electroless nickel layer.

59. The structure of claim 46, including:

a double zincation activated surface on the metal cap layer;

a electroless nickel layer on the double zincation activated surface; the electroless nickel layer having a thickness of from about 4.8 to 5.2 μm; and

an immersion gold layer on the electroless nickel layer; the immersion gold layer having a thickness of from about 0.09 to 0.11 μm.

60. The structure of claim 46, including:

a double zincation activated surface on the metal cap layer;

a electroless nickel layer on the double zincation activated surface; the electroless nickel layer having a thickness of about 5.0 μm; and

an immersion gold layer on the electroless nickel layer; the immersion gold layer having a thickness of about 0.10 μm.

61. The structure of claim 46, wherein the solder bump is rounded.

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62. A solder bump structure, comprising:

a structure;

a metal bond pad on the structure;

a patterned cover layer over the structure; the patterned cover layer including an opening exposing a portion of the metal bond pad; the patterned cover layer opening including side walls;

a metal cap layer over at least the exposed portion of the metal bond pad and the patterned cover layer side walls; the metal cap layer including a double zincation activated upper surface;

a electroless nickel layer over the double zincation activated upper surface of the metal cap layer;

an immersion gold layer over the electroless nickel layer; and

a solder bump over the immersion gold layer to form the solder bump structure.

63. The structure of claim 62, wherein the structure is a semiconductor wafer.

64. The structure of claim 62, wherein the structure is comprised of silicon or germanium.

65. The structure of claim 62, wherein the metal bond pad is comprised of aluminum or AlSi; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum or AlSi; and the solder bump is comprised of a tin lead alloy (SnPb), a tin silver copper alloy (SnAgCu), a tin silver alloy (SnAg) or a tin copper (SnCu).

66. The structure of claim 62, wherein the metal bond pad is comprised of aluminum; the patterned cover layer is comprised of a polyimide/benzocyclobutene stack; the metal cap layer is comprised of aluminum; and the solder bump is comprised of a tin silver copper alloy (SnAgCu).

67. The structure of claim 62, wherein the metal bond pad and the metal cap layer are each comprised of the same metal.

68. The structure of claim 62, wherein the metal bond pad has a thickness of from about 0.5 to 1.5 μm; the patterned cover layer has a thickness of from about 5.0 to 10.0 μm; and the metal cap layer has a thickness of from about 0.5 to 1.0 μm.

69. The structure of claim 62, wherein the metal bond pad has a thickness of from about 1.0 1.5 μm; the patterned cover layer has a thickness of from about5.0 to 6.0 μm; and the metal cap layer has a thickness of from about 0.8 to 1.0 μm.

70. The structure of claim 62, wherein the patterned cover layer opening has a width of from about 30 to 90 μm.

71. The structure of claim 62, wherein the patterned cover layer opening has a width of from about 30 to 60 μm.

72. The structure of claim 62, wherein the metal cap layer is formed by sputtering.

73. The structure of claim 62, wherein the solder bump is rounded.

74.The structure of claim 62, wherein the electroless nickel layer has a thickness of from about 4.8 to 5.2 μm; and the immersion gold layer having a thickness of from about 0.09 to 0.11 μm.

75.The structure of claim 62, wherein the electroless nickel layer has a thickness of about 5.0 μm; and the immersion gold layer having a thickness of about 0.10 μm.